B.E. (Mechanical Engineering)

SEMESTER-V

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	6HS502HS	Managerial Economics and Financial Accounting (MEFA)	3	-	-	3	40	60	3
2	6HS503HS	Effective Technical Communication	2	-	-	2	40	60	2
3	6PC508ME	Computer Aided Design & Manufacturing	3	-	-	3	40	60	3
4	6PC509ME	Design of Machine Elements I	3	1	-	4	40	60	4
5	6PC510ME	Metrology and Machine Tools	3	-	-	3	40	60	3
6	PE	Professional Elective I / MOOC's	3	-	-	3	40	60	3
7	OE	Open Elective I**	3	-	-	3	40	60	3
Practical / Laboratory									
8	6PC556ME	Metrology and Machine Tools Lab	-	-	2	2	40	60	1
9	6PC557ME	CAD/CAM Lab	-	-	2	2	40	60	1
10	6PW551ME	Internship -I	-	-	2	2	40	60	1
11	6MC552ME	Skill Development Lab-2 /Value Added Course	-	-	2	2	50	*S/U	-
Total			**20**	**1**	**8**	**29**	**450**	**600**	**24**

Professional Elective I :

1. 6PE501ME Automobile Engineering
2. 6PE502ME Experimental Stress Analysis
3. 6PE503ME Modern Machining & Forming Methods
4. 6PE504ME Advances in Welding and Joining **(MOOC's-2C)**

****O.E.I→1**. 6OE501ME Start-up Entrepreneurship.

** Subject is not offered to the students of Mech. Engg. Department.

Course Code	Course Title						Core/Elective
6HS502HS	MANAGERIAL ECONOMICS & FINANCIAL ACCOUNTING						HS
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To understand responsibilities of a manager of a business undertaking.
2. To analyze various determinants influencing demand and price.
3. To understand the principles of accounting and prepare Journal, Ledger, Trial Balance & Final accounts.
4. To understand Financial statement Analysis.
5. To evaluate & analyze the long term investments.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Determine the responsibilities & decision making in the Organization.
2. Understand the various factors influencing demand & market structure.
3. Understand the principles of Accounting & solve the problems.
4. Analyze the Financial performance.
5. Understand the capital structure & to take decision on selection of projects.

UNIT - I

Introduction to Managerial Economics, its Scope, Importance and relation to other sciences, its usefulness to Engineers-Basic concepts of Managerial Economics.

UNIT - II

Demand Analysis: Introduction to demand, determinants, law of demand, its assumptions, Elasticity of demand-price, income and cross elasticity, demand forecasting, Market competitive structure price & output determination under perfect competition and Monopoly.

UNIT - III

Basics of Accounting: Financial Accounting–Definition - Accounting Cycle- Journal - Ledger - Cash book - Trial Balance.

UNIT - IV

Financial statement Analysis: - Preparation of Final accounts with simple adjustments (including Problems). Ratio Analysis – Importance – Liquidity and profitability ratios.

UNIT - V

Capital management: Significance determinates and estimation of fixed and working capital requirements, sources of capital. Introduction to capital budgeting, Time Value of money - Methods: Non-Discounted cash flow methods (pay back, ARR), Discounted (NPV, PI, IRR) with problems.

TEXT BOOKS :

1. Mehta P.L., Managerial Economics, Sultan Chand & Sons Publishers.
2. Managerial Economics - A Problem Solving Approach, by Luke M Froeb.
3. I.M.Panday Financial Management, Vikas Publishing House.
4. Maheswari S.N. Introduction to Accountancy. Vikas Publishing House.

REFERENCE BOOKS :

1. R.L.Varshney, K.L.Maheshwari, Managerial Economics, Sultan Publishers.
2. D.M.Mithani, Managerial Economics, Himalaya Publishing House.
3. Mukherjee, Hanif, Financial Accounting, Tata McGraw Hill.
4. Ramachandran, Kakani, Financial Accounting for Management, Tata McGraw Hill.

Course Code	Course Title						Core/Elective
6HS503HS	EFFECTIVE TECHNICAL COMMUNICATION						HS
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	2	-	-	-	40	60	2

COURSE OBJECTIVES:

1. To Understand the process, features and barriers of Communication.
2. To learn the aspects of communication and Presentation.
3. To comprehend the types of official and business correspondence.
4. To analyze the techniques of Report Writing
5. Aspects of data transfer and presentation.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Handle Technical Communication effectively by overcoming barriers of communication.
2. Use different types of Professional correspondence to communicate effectively.
3. Use different types of Business and Inter Office Correspondence.
4. Acquire adequate skills to draft reports efficiently.
5. Enhance their skills of information transfer.

UNIT-I

Introduction to Communication : Definition, process and Channels of Communication. ABC of Technical communication. Barriers to communication. Differences between general and Technical writing.

UNIT-II

Aspects of Communication : Importance of listening and types of Listening. Types of Technical communication (Oral and Written). Features of technical communication (Precision, relevance, format, style & Use of visual aids). Persuasive Techniques.

UNIT-III

Emails, IOM, Business Letters - enquiry and response; compliant and Adjustment; placement of order; Cover letters/Job Application & Resume Writing. Business proposals.

UNIT - IV

Technical Writing –II : Types of technical reports (Informative, analytical, periodic, Special, formal and Informal) Formal Elements of a Report. Feasibility, Project, Progress and Evaluation reports.

UNIT - V

Information Transfer and Presentations : Non-verbal to verbal. Verbal to non – verbal. Important aspects of oral and Visual Presentations.

TEXT BOOKS:

1. Raman, Meenakshi & Sharma, Sangeeta. Technical Communication: Principles and Practice (3rd ed.). New Delhi.OUP.
2. Rizvi, Ashraf, M. Effective Technical Communication (2 nd ed.) New Delhi, Tata McGraw Hill Education.

REFERENCE BOOKS:

1. Tyagi, Kavita & Misra, Padma. Advanced Technical Communication.New Delhi, PHI Learning.
2. Jungk, Dale. Applied Writing for technicians. Newyork, McGraw Hill Higher Education.
3. Sharma, R. C,& Mohan , Krishna. Business Correspondence and Report Writing: A Practical approach to business & technical communication (4 th ed.) New Delhi, Tata McGraw Hill Education.

Course Code	Course Title						Core/Elective
6PC508ME	COMPUTER AIDED DESIGN AND MANUFACTURING						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To introduce the concepts of CAD and advanced modelling techniques.
2. To understand the functioning of computer numerical control machine tools and also in writing programs for operating these machines.
3. To understand the advanced manufacturing concepts like Group technology, flexible manufacturing systems, Computer aided Process Planning; Computer aided quality control, Artificial Intelligence etc.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the fundamental concepts and principles of CAD and evaluate geometric transformations in both 2D and 3D design space.
2. Apply the concepts and principles of wireframe modelling to create accurate representation of objects.
3. Create the realistic and functional designs by combining surface, solid and assembly modelling techniques effectively.
4. Create the Numerical Control (NC) programs using different methods of part programming both manual and computer assisted programming tools.
5. Understand the basic concepts and components of Flexible Manufacturing Systems (FMS), and Automated Material Handling Systems.

UNIT-I

Introduction to CAD, Product cycle, Design process, Design criteria, Benefits of CAD/ CAM – Design workstation, CAD/ CAM database and structure. Data Exchange Formats (IGES, STEP).

Geometric 2D & 3D Transformations: Introduction, Translation, Rotation, Scaling, Reflection Transformations, Homogenous Representation, Concatenated Transformation.

UNIT - II

Wire frame Modelling: Wireframe entities and their definition, interpolation and approximation curves. Parametric and non-parametric representation- line, circle and helix curves, properties of splines, synthetic curves: parametric representation of cubic spline, Bezier and B-spline curves, continuity, properties and characteristics. Introduction to NURBS.

UNIT - III

Surface Modelling: Surface representation, Analytic surfaces: definition of Plane surface, Ruled surface, Surface of revolution, Tabulated cylinder, Synthetic surfaces-Hermite cubic and Bezier surfaces.

Solid Modelling: Solid entities, Boolean operations, B – rep and CSG approaches, feature based modelling, Assembly modelling.

UNIT - IV

NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming.

Group Technology: Part families, layout, part classification and coding system. MICLASSCODE system.

UNIT - V

Flexible Manufacturing System: Introduction & Component of FMS, Needs of FMS, general FMS consideration, Objectives, Types of flexibility and FMS, FMS layout and advantages. Automated material handling system: Types and Application, Automated Storage and Retrieval System, Automated Guided Vehicles.

TEXT BOOKS:

1. CAD CAM Theory and Practice: Ibrahim Zeid, McGraw Hill.
2. CAD/CAM: Computer Aided Design and Manufacturing, by Groover, Pearson India.

REFERENCE BOOKS:

1. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P Groover, Pearson Education
2. P. Radhakrishnan, “Computer Numerical Control ", New Central Book Agency.
3. Computer integrated manufacturing -S. Kant Vajpayee – Prentice Hall of India.

Course Code	Course Title						Core/Elective
6PC509ME	DESIGN OF MACHINE ELEMENTS- I						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engineering mechanics & mechanics of solids.	3	1	-	-	40	60	4

COURSE OBJECTIVES:

1. To understand the general design procedures and principles in the design of machine elements.
2. To study different materials of construction and their properties and factors determining the selection of material for various applications.
3. To determine stresses under different loading conditions.
4. To learn the design procedure of different fasteners, joints, shafts and couplings.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the standards, codes, Theories of failure, various design considerations for joints, Power screws, stress, strains and Mechanical elements like shafts, keys, couplings, Joints.
2. Select the suitable shafts, Keys, couplings, Permanent and temporary Joints for a given application.
3. Demonstrate the ability to apply the fundamentals of stress analysis, theories of failure and material science in the design of Mechanical components of shafts, keys, couplings, Joints and power screws.
4. Analyze and evaluate shafts, keys couplings, Joints and power screws subjected to static and dynamic loads.
5. Design of Keys, couplings, curved beams, Permanent and temporary joints for a given application using various empirical relations.

UNIT - I:

Introduction: Materials used in machine design and their specifications to Indian standards, codes and standards used in design.

Reliability, principles of Ergonomics and Manufacturing considerations, preferred numbers. Analysis of stress and strain: Types of loading and stresses.

Theories of failure under static loading, stress concentration factor, factor of safety, Design of components for static loads and Fatigue loads

UNIT- II :

Design for Fatigue Strength: Stress concentration–Theoretical stress Concentration factor–Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Gerber's curve– Goodman's diagram– Soderberg's diagram for fatigue design.

UNIT - III:

Shafts: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code.

Couplings: Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Flange coupling (Modified).

Keys: Types and design of keys-stresses in keys.

UNIT - IV:

Design of Permanent Joints: Types of Riveted joints, efficiency of the joint. Design of riveted joints subjected to direct and eccentric loads.

Types and design of welded joints subjected to direct and eccentric loading.

UNIT - V:

Design of Bolted Joints & Power Screws: Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints, design of power screws and screw jack.

Cotter and knuckle joints: Introduction, Type of Cotter joints, Design of Socket and Spigot Cotter joints, Sleeve Cotter joints and Knuckle joints

Introduction to design optimization: General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, design constraints, classification of optimization problems. Single and multivariable optimization techniques.

TEXT BOOKS:

1. Design of Machine Elements / V. Bhandari / Mc Graw Hill.
2. Machine design/RS Khurmi.

REFERENCE BOOKS:

1. Machine Design / Jindal / Pearson.
2. Design of Machine Elements / V. M. Faires / Macmillan.
3. Design of Machine Elements-I / Kannaiah, M.H / New Age.

Course Code	Course Title						Core/Elective
6PC510ME	METROLOGY AND MACHINE TOOLS						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

Students will be able to

1. To have knowledge of various precision linear and angular measuring instruments.
2. To familiarize with Limits & fits, I.S.O. system and the instruments used to measure these limits.
3. To learn the principle and working of various machine tools like lathe, shaper, planer, milling, drilling and grinding machines etc.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Understand the concept of metrology and its significance in ensuring accurate measurements.
2. Apply the principles of inter-changeability, selective assembly, and determine tolerance grades, fits, and types of fits.
3. Understand the principles and operation of various comparators, tool maker's microscopes, surface roughness measurement instruments, and thread metrology methods.
4. Understand the constructional features and specifications of machine tools, including lathes, drilling, boring, milling and grinding machines.
5. To determine the cutting forces and machining time in lathe, milling, drilling and boring operations.

UNIT - I

Introduction to Metrology: Definition, objectives of metrology, Material Standards, Wavelength Standards, Classification of Standards, Line and End Standards.

Liner measurement and angular measurements: Different types of Micrometers, Height gauges. Slip gauges-Indian standards on slip gauges, Wringing of slip gauges, Measurement of angle-Sine bar, Autocollimator-Applications for measuring straightness.

System of Limits, Fits, Tolerance and Gauging: Definitions, Tolerance, Intercangeability & Selective assembly. Tolerance grades, Fits, Types of fits, Problems on limits, fit and tolerance. Hole base system & shaft base system. Taylor's principle, Types of limit gauges, Numerical on limit gauge design.

UNIT - II

Comparators: Mechanism of Dial indicator, Mechanical comparators. Free flow and Back pressure type Pneumatic comparator. Electrical and Optical comparator. Tool maker's Microscope applications, Measurement of straightness, flatness and roundness with bench centre and talyrond.

Surface Roughness Measurements- Profilometer, Taylor Hobson Talysurf. Application of Thread metrology - 2 wire and 3 wire methods. Gear tooth thickness, General geometric tests for machine tools – Lathe, Drill and Mill.

UNIT-III

Metal cutting: Introduction, elements of cutting process – Geometry of single point cutting tools. Chip formation and types of chips.

Engine lathe – Principle of working, types of lathe, specifications. Taper turning, – Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts.

UNIT - IV:

Drilling and Boring Machines – Principles of working, specifications, types, and operations performed; twist drill. Types of Boring machines and applications. Shaping, slotting and planing machines –Principles of working – machining time calculations.

UNIT - V

Milling machines – Principle of working – Types of milling machines – Geometry of milling cutters, methods of indexing, machining time calculations.

Grinding – Theory of grinding, classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel, Lapping, honing and broaching machines, comparison and constructional features.

TEXT BOOKS:

1. M.Mahajan-" Metrology", Dhanpat Rai & Co.(P)Ltd, New Delhi.
2. P.N. Rao, "Manufacturing Technology - Metal Culling & Machine Tools", Vol. 2. Tata McGraw Hill Education Pvt. Ltd.

REFERENCE BOOKS:

1. K.L.Narayana-"Engineering metrology", third edition, Scitech Publications Pvt. Ltd.
2. I.C. Gupta – "Engineering metrology", Dhanpat Rai Publications, New Delhi.
3. RK Jain, "Engineering Metrology", Khanna Publications, 1996.

Course Code	Course Title						Core/Elective
6PE501ME	AUTOMOBILE ENGINEERING						PE-1
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES :

The objective of this course is to make the student to

1. Learn the anatomy of the automobile, basic structure and super structure.
2. Understand the location and importance of each engine components.
3. Learn the functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels.
4. Study the Suspension, springs and other connections of systems.
5. Understand Emissions, pollution regulations, EURO and BHARATH stages and servicing of automobile.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Understand the different parts and constructional details of the automobile engines.
2. Understand the working of various systems like engine lubricating system and cooling system, types of ignition system and different batteries used in automobile.
3. Explain the constructional and working principle of steering, suspension systems, braking system and steering systems.
4. Select suitable braking system, steering mechanism, suspension system and cooling system for different automobile vehicles.
5. Explain the effect of automobile pollution on environment and necessity of pollution norms along with trouble shooting.

UNIT - I

Types of automobiles: Conventional, Electrical and Hybrid Vehicles: Series and parallel systems, Hydrogen Fuel cell vehicle. Engine location, Chassis layout and Engine components-cylinder block, cylinder head, crankcase, inlet and exhaust

manifolds, gaskets, cylinder liners, constructional features of piston, piston slap, methods to overcome piston slap. Piston rings, compression rings, oil control rings, crank shaft. Valve Operating Mechanisms, inlet and exhaust manifolds.

Fuel supply systems: Fuel supply system for petrol and diesel engines, single point and multipoint injection (MPFI), mechanical and electronic injection system, CRDI system and its present scenario.

UNIT–II

Lubricating Systems: Mist (Petroil) System, Wet sump and Dry Sump.

Cooling systems: Air Cooling, Water cooling: Thermosiphon, pump circulation system, components of cooling system- Radiator, Thermostat Control and Anti Freezing agents.

Ignition Systems: Types of Ignition Systems, Modern Ignition systems.

Batteries: Types of Batteries and charging systems- Batteries used in Electric and Hybrid Vehicles, starting motors.

Electrical Systems: Main electrical circuits, generating & starting circuit, lighting system, indicating devices, warning lights, speedometer, automobile air-conditioning.

UNIT-III

Steering Systems: Linkage arrangements and its components, steering gear box types, recent trends, Davis Steering, Modified Ackerman linkage.

Steering geometry: wheel alignment, caster, camber, King Pin Inclination, Toe in, Toe out.

Wheel and Tyres: Tyre construction, specification. Tyre wear and causes.

Suspension systems: Types of Suspension systems, Independent suspension, coil and leaf springs, torsion bar, shock absorbers.

UNIT-IV

Power Train: Single & Multi Plate Clutch, Cone clutch. Manual Gear Box: Constant Mesh, Sliding Mesh, Synchromesh. Automatic Gear Box, Torque Converter, Propeller Shaft, Universal Coupling, Differential, four wheel drive system.

Brakes Systems: Disc and drum types, leading and trailing shoe layout, Description and operation of hydraulic brake, hand brake linkage, Pneumatic, air and vacuum brakes, ABSand SRS Airbag system.

UNIT – V

Automobile Emissions and control: Emissions from automobiles and its control techniques used for petrol and diesel engines, PCVS, EGR, SCRT, Thermal Reactors, Catalytic converters; Euro norms and Bharat Norms.

Maintenance: Trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul testing equipment.

TEXT BOOKS:

1. Kirpal Singh., -Automobile Engineering, Vol. I & II Standard Publishers, Delhi.
2. Er. S.K. Gupta- Automobile Engineering, S.Chand Publications, New Delhi.

REFERENCE BOOKS:

1. Crouse & Anglin, -Automotive Mechanics, 10/e, TMH. Publishing Co. Ltd., New Delhi.
2. Joseph Heitner, -Automotive Mechanics, 2/e, Affiliated East West Pvt. Ltd.
3. R.K. Rajput, -A Textbook of Automobile Engineering, Laxmi Publications, New Delhi.
4. D S Kumar, -Automobile engineering, S K Kataria Publications, New Delhi.

Course Code	Course Title						Core/Elective
6PE502ME	EXPERIMENTAL STRESS ANALYSIS						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engg. Physics	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. Demonstrates principles of experimental approach
2. Teaches regarding the working principles of various strain gauges.
3. Throws knowledge on strain rosettes and principles of non destructive testing of concrete.
4. Gives an insight into the principles of photo elasticity.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the different methods of experimental stress analysis and use of strain gauges for measurement of strain
2. Explain the measurement of strain under static and dynamic loads
3. Summarize the principles of experimental approach
4. Analyze theory of photo elasticity and its applications in analysis of structures.
5. Evaluate experimental method of finding the response of the structure to different types of load.

UNIT-I

PRINCIPLES OF EXPERIMENTAL APPROACH: Merits of Experimental Analysis Introduction, uses of experimental stress analysis, advantages of experimental stress analysis, different methods –simplification of problems.

UNIT-II

STRAIN MEASUREMENT USING STRAIN GAUGES: Definition of strain and its relation of experimental determinations, properties of Strain gauge Systems-types of strain gauges –Mechanical, Acoustic and Optical Strain Gauges. Introduction to Electrical strain gauges -Inductance strain gauges –LVDT –Resistance strain gauges –various types –Gauge factor –Materials of adhesion base.

UNIT-III

STRAIN ROSSETTES AND NON–DESTRUCTIVE TESTING OF CONCRETE: Introduction –the three elements Rectangular Rosette –The Delta Rosette Corrections for Transverse Strain Gauge. Ultrasonic Pulse Velocity method – Application to Concrete. Hammer Test.

UNIT -IV

THEORY OF PHOTOELASTICITY: Introduction –Temporary Double refraction – The stress Optic Law –Effects of stressed model in a polariscope for various arrangements – Fringe Sharpening. Brewster?s Stress Optic law.

UNIT -V

TWO DIMENSIONAL PHOTO ELASTICITY: Introduction –Iso-chromatic Fringe patterns-Isoclinic Fringe patterns, passage of light through plane Polariscope and Circular polariscope, Isoclinic Fringe patterns –Compensation techniques – Calibration methods – Separation methods –Scaling Model to prototype Stresses – Materials for photo elasticity and properties of Photo elastic materials.

TEXT BOOKS:

1. Dr.Sadhu Singh, "Experimental stress analysis", khanna Publishers.
2. U.C.Jindal, "Experimental Stress analysis", Pearson Publications.

REFERENCE BOOKS:

1. J.W.Dally and W.F.Riley, "Experimental stress analysis College House Enterprises"
2. L.S.Srinath, "Experimental Stress Analysis", MC.Graw Hill Company Publishers.

Course Code	Course Title						Core/Elective
6PE503ME	MODERN MACHINING & FORMING METHODS						PE-I
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Mfg. Processes	-	3	-	-	40	60	3

COURSE OBJECTIVES:

1. To know the importance of unconventional machining and forming processes.
2. To learn the working principle of various modern machining and forming processes.
3. To understand the advantages, limitations and applications of various modern machining and forming processes.
4. To understand the relationship between process parameters and performance of various processes.
5. To know the suitability of processes for various engineering materials and applications.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Understand the classification and need of non traditional machining technology in modern manufacturing.
2. Understand the principle and operation of USM, AJM, AWJM, WJM, EDM, EDG, ECM, CHM, LBM, EBM and PAM processes.
3. To determine the effect of process parameters on the performance and material removal rate in USM, AJM, WJM, AWJM, EDM, EDG, ECM, CHM .
4. Understand the principle, description & applications of stretch forming, tube spinning, hydrostatic forming and water hammer forming techniques.
5. To find the suitability of various types of modern machining and high energy rate forming methods in industrial applications.

UNIT-I

Introduction: Need for non-traditional machining processes, selection, classification & comparative study of different processes; Ultrasonic Machining (USM):

Introduction, process description, abrasive slurry, Abrasive materials and their characteristics. Functions of liquid medium in slurry, Types of Transducers, effect of process parameters, applications and limitations; **Abrasive Jet Machining (AJM):** Principle of operation, process details, process variables and their effect on MRR and accuracy. Equation for MRR Advantages, disadvantages and applications; **Water Jet Machining (WJM):** Schematic diagram, equipment used, advantages and applications; **Abrasive Water Jet Machining (AWJM):** Schematic diagram, equipment used, advantages and applications.

UNIT – II

Electro-Chemical Machining (ECM): Schematic diagram of process parameters, function and characteristics of electrolyte, chemistry of the process, Equation for specific MRR and electrode feed rate, advantages, limitations and applications; **Electro Chemical Grinding:** Process description and applications.

Electro Discharge Machining (EDM): Process description with schematic diagram, process parameters, functions and characteristics of dielectric medium, dielectric fluids, over cut and side taper? Flushing, Mechanism of metal removal, crater volume, types of power supply circuits, mathematical analysis of metal removal rate (MRR), characteristics of spark eroded surfaces, advantages, disadvantages and applications. **Wire EDM:** Process description and applications; Electro Discharge Grinding: Process description and applications;

UNIT – III

LASER Beam Machining (LBM): Principle of LASER Beam production, materials used, thermal analysis of the process, process parameters, equations for power density and machining rate, advantages, limitations and applications; **Plasma Arc Machining (PAM):** Introduction equipment used, process description and parameters, types of plasma arc - Transferred arc and non transferred arc; advantages, disadvantages and applications; **Electron Beam Machining (EBM):** Schematic diagram og process, process parameters, principle of production of Electron beam, equipment used, Advantages, disadvantages and applications; Ion Etching: Process description and applications.

UNIT – IV

High Energy Rate Forming (HERF): Introduction, comparison of conventional & high energy rate forming methods. Types of high energy rate forming methods; Explosive Forming: principle, Explosive materials, types of explosive forming -

standoff operation and contact operation, advantages, disadvantages and applications; **Electro-Hydraulic forming (EHF):** Schematic of the process description and its applications; **Electro-Magnetic Forming (EMF):** Schematic diagram of the process description and its applications; **Rubber Pad Forming:** Principle, process details and its types; Guerin, wheel on, Marforming and Hydro forming processes and applications.

UNIT – V

Stretch Forming: Introduction, types of stretch forming - stretch draw forming, rotary stretch forming or stretch wrapping, compression forming and radial draw forming, Stretch forming equipment and accessories, accuracy and surface finish, process variables, limitations and applications; Tube spinning: Introduction, methods of tube spinning - backward spinning, Forward spinning; machines and tools used, machine variables - speeds and feeds; effect of tube spinning on work metal properties and applications; **Hydrostatic Forming:** Process principle, description and applications; **Water Hammer Forming (WHF):** Schematic diagram of the process, principle of operation, process variables, work materials, process limitations and applications.

TEXT BOOKS:

1. P.K.Mishra "Non Traditional Machining processes" Narosa Publications, New Delhi.
2. V.K Jain "Advanced Machining Processes" Allied Publishers, Hyderabad.

REFERENCE BOOKS:

1. HMT Production Technology, Tata McGraw Hill Publications.
2. Modern Machining Processes - P. C. Pandey, H. S. Shan/ Mc Graw Hill
3. Manufacturing Technolgy, Kalpakzian, Pearson.
4. New Technology, Bhattacharya A, the Institution of Engineers, India.

Course Code	Course Title						Core/Elective
6PE504ME	ADVANCES IN WELDING AND JOINING						PE-1
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. Understand the various types of solid state welding and advanced welding processes available.
2. Gain knowledge of the weldability concepts and operating procedures of ferrous metal and non ferrous metals.
3. To gain the knowledge of defects, remedial procedure and testing methods in welded joints.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Explain the concept and applications of solid state welding.
2. Apply the knowledge of advanced welding techniques in manufacturing industries.
3. Select the welding procedure for joining ferrous materials.
4. Apply the knowledge of welding and joining of non ferrous metals in industrial application.
5. Explain the welding defects, remedial measures and testing procedure in ferrous and non ferrous joints.

UNIT - I :

SOLID STATE WELDING PROCESS: Solid state welding process- Cold welding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, MIAB welding and hot pressure welding processes - advantages, limitations and applications.

UNIT - II :

ADVANCED WELDING PROCESS: Atomic hydrogen welding, Electron Beam welding, Laser Beam welding, Friction Stir welding, Cold Metal Transfer welding, Under Water welding- advantages, limitations and applications.

UNIT - III:

WELDING AND JOINING OF FERROUS METALS: Weldability of cast irons: Gray cast iron, White cast iron and Malleable cast iron. Weldability of Carbon steel- low carbon steel, medium carbon steels and high carbon steels. Weldability of Stainless steels - austenitic, ferritic, martensitic stainless steels.

UNIT - IV:

WELDING AND JOINING OF NON- FERROUS METALS: Weldablity of copper and its alloys, Weldablity factors, welding of copper and its alloys, brazing and soldering of copper and its alloys. Weldablity of aluminium alloys, problems associated with welding of aluminium; Welding of Ti and Ni alloys

UNIT - V :

WELD DEFECTS AND TESTING OF WELDS : Welding defects, their causes and remedial measures; Hot cracking and cold cracking; distortion in welding; Weldability tests- Destructive and non-destructive testing of weldments- liquid penetrant, magnetic particle, ultrasonic and radiographic testing.

TEXT BOOKS :

1. Parmer R. S., 'Welding Engineering and Technology', Khanna Publishers.
2. Cary, Howard, "Modern Welding Technology", prentice Hall.

REFERENCE BOOKS :

1. Linnert G. E.,'Welding Metallurgy', Volume I and II, 4th Edition, AWS.
2. Granjon H., 'Fundamentals of Welding Metallurgy', Jaico Publishing House.
3. Kenneth Easterling, 'Introduction to Physical Metallurgy of Welding', 2nd Edition, Butterworth Heinmann.

Course Code	Course Title						Core/Elective
6PC556ME	METROLOGY AND MACHINE TOOLS LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	40	60	1

COURSE OBJECTIVES:

1. To have knowledge of various precision measuring instruments.
2. To familiarize various machining and metal cutting operations

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Apply the principles and techniques of measurement using inside, outside, and depth micrometers, Vernier callipers, and height gauges.
2. Apply the principles and techniques of measuring roundness errors and ovality using V-blocks and dial bore gauge.
3. Determine the angles with precision using Sine bar and Bevel protractor. Accurately measure linear and angular dimensions using a Tool Maker's Microscope
4. Apply the lathe machine operations, thread cutting, drilling, gear cutting, and shaping techniques on work pieces accurately and effectively.
5. Analyze the cutting force during machining operations using a lathe tool dynamometer

LIST OF EXPERIMENTS:

A) Metrology

1. Measurement with inside, outside and depth micrometers, Vernier callipers and Height gauges.
2. Measurement of roundness errors with V-block and dial gauge.
3. Measurement of Linear and Angular dimensions with Tool Maker's Microscope.
4. Measurement of angles with Sine bar, Bevel protractor.
5. Measurement with Dial Indicator/Dial Bore Gauge.

B) Machine tools

1. Facing, plain turning, step turning and taper turning on the lathe machine.
2. Thread cutting and knurling on the lathe machine.
3. Drilling, boring and tapping.
4. Gear Cutting on milling machine.
5. Perform shaping operation.
6. Measurement of Cutting forces with Lathe tool dynamometer.

Note: At least ten experiments should be conducted in the Semester.

Course Code	Course Title						Core/Elective
6PC557ME	CAD/CAM LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
AUTO CAD	-	-	-	2	40	60	1

COURSE OBJECTIVES:

1. To learn the design criteria of machine components, selection of materials and manufacturing Process.
2. To familiarize with NC features, part programming using G and M codes, APT, CNC, DNC and FMS etc.

COURSE OUTCOMES:

1. Create the models of the components.
2. Develop the production drawings of the parts from the given assembly drawing.
3. Generate the bill of materials and indicate details pertaining to manufacturing requirements.
4. To develop a simple part program to perform machining on a CNC machine.
5. To operate CNC machine and perform various machining operations.

LIST OF EXPERIMENTS

1. Part modelling-I from given assembly drawings using any solid modelling package.
2. Part modelling-II from given assembly drawings using any solid modelling package.
3. Geometrical dimensioning and tolerance representation on part drawings.
4. Conventional practices to indicating Dimensional, Form & Position tolerances.
5. Calculation of limits, suggestion of suitable fits for mating parts with Interference detection.
6. Surface finish, surface treatments- specification and indication methods on the drawings.
7. Generation of production drawings in 2D from part models representing Limits, fits, tolerances, Surface finish, geometrical and form tolerance etc.
8. Preparation of Process sheet incorporating Tool work orientation diagrams.
9. Performing Facing and Turning operations on CNC lathe.
10. Performing Step turning and taper turning operations on CNC lathe.
11. Pocketing and Contouring on CNC lathe.

Note: At least 10 experiments should be conducted in the Semester

Course Code	Course Title						Core/Elective
6PW551ME	INTERNSHIP-1						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	40	60	1

COURSE OBJECTIVES :

1. Produce an accurate record of work performed during the Internship
2. Apply engineering knowledge to a problem in industry
3. Produce a technical report
4. Discuss work in a team environment, if relevant to the project
5. Conduct herself/himself responsibly, safely, and ethically in a professional environment

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. To develop and enhance technical skills.
2. To apply the theoretical knowledge they have acquired in their academic courses.
3. To develop practical skills that are relevant to their academic courses
4. To gain industry-specific knowledge that aligns with their academic courses
5. To engage in professional communication and collaborate with colleagues, supervisors and industry persons.

Internship is introduced as part of the curriculum of encouraging students to work on problems of interest to industries. A batch of two to three students will be attached to a person from the Government or Private Organizations/Computer Industry/Software Companies/R&D Organization for a period of 2 weeks. This will be during the summer vacation following the completion of the IV Semester Course work.

One faculty coordinator will also be attached to each group (of 2 or 3 students) to monitor the progress and to interact with the industry co-ordinate (person from industry). The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship.

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the internship and

2. Present the work through a seminar talk (to be organized by the Department)

Award of Sessional marks are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (40 Marks) followed by presentation before the committee constituted by the department (60 Marks).

One faculty member will co-ordinate the overall activity of Industry Attachment Program.

Note: Students have to undergo summer internship of 2 weeks at the end of semester IV and credits will be awarded after evaluation in V semester.

Course Code	Course Title						Core/Elective
6MC552ME	SKILL DEVELOPMENT LAB-2 / VALUE ADDED COURSE						MC
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	50	*S/U	-

COURSE OBJECTIVES :

The course objectives are: To

1. Complement the core curriculum and provide additional knowledge, skills, and experiences.
2. Provide students with in-depth knowledge and expertise in a particular field of interest.
3. Foster critical thinking skills and develop the ability to approach engineering challenges from multiple perspectives.
4. Equip students with the skills and knowledge needed to excel in their careers and adapt to the evolving demands of the industry.
5. Bridge the gap between academic knowledge and practical application, preparing students for real-world challenges.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Gain insights into the professional aspects of mechanical engineering.
2. Hands-on experience with tools, equipment, and software used in the industry.
3. Collaborate, communicate ideas, and work effectively as part of a team.
4. Improve the critical thinking abilities and adapt to the evolving demands of the industry.
5. Solve complex problems, and make informed decisions.

Value-added courses in mechanical engineering are designed to supplement the core curriculum and provide students with additional skills and knowledge that can enhance their career prospects. These courses go beyond the fundamental concepts taught in traditional mechanical engineering programs and focus on specialized

areas or emerging technologies. Value-added courses in mechanical engineering under "Skill Development Lab-2" may be considered in the following areas of specialization.

Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM): These courses provide training in using software tools like Solid-Works, CATIA, or Pro/ENGINEER for designing and modelling mechanical components. Students learn to create 2D and 3D models, perform simulations, and generate manufacturing instructions.

NDT: NDT stands for Non-Destructive Testing, which is a set of techniques used to evaluate the integrity, quality, and reliability of materials, components, and structures without causing any damage to them. NDT plays a critical role in ensuring the quality, safety, and reliability of various industries by enabling the detection of defects and flaws that may compromise the integrity of materials and structures.

Students should undergo training in any of the above mentioned courses with minimum of 30 hours duration and should submit a course completion certificate from the respected authorities.

Course Code	Course Title						Core/Elective
6OE501ME	START- UP ENTREPRENEURSHIP						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES :

Students should be able to understand

1. To motivate students to take up entrepreneurship in future.
2. To learn nuances of starting an enterprise & project management.
3. To understand project formulation and choice Technology in Enterprise.
4. To understand Intellectual properties, patents, Start-ups.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Understand Entrepreneurship and Economic growth, Small and Large Scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Understand the concept of Intellectual Property Rights and Patents
5. Comprehend the aspects of Start-Ups.

UNIT -1

Entrepreneurship: Definition, functions of Entrepreneurship, Characteristics and qualities of entrepreneurs, Entrepreneur vs. intrapreneur, need of innovation, Economic growth. Small Scale Industry in India, Linkage among small, medium and heavy industries.

UNIT – II

Indian Industrial Environment: Competence, Opportunities and Challenges, Emergence of First generation entrepreneurs, women entrepreneurs. Conception and evaluation of ideas and their sources. Types of enterprises. Collaborative interaction for Technology development. Corporate Social Responsibility

UNIT – III

Project formulation: Introduction, Elements of Business Plan and its salient features, Analysis of market demand, Financial and profitability analysis and Technical analysis.

UNIT -IV

Intellectual Property Rights: Meaning, Nature, Classification and protection of Intellectual Property, the main forms of Intellectual Property, Concept of Patent, Patent document, Invention protection, Granting of patent, Rights of a patent, Licensing, Transfer of technology.

UNIT -V

Aspects of Start-Up: What is Start-Up, Start-up Policy, start-up strategy, Progress of startups in India, Principles of future organizations, start-up sectors and action plan for start-ups by Govt. of India.

TEXT BOOKS:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House,
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata McGraw-Hill Publishing Company Ltd.
3. Ajit Parulekar and Sarita D'Souza, Indian Patents Law – Legal & Business Implications, MacmillanIndia Ltd.

REFERENCE BOOKS:

1. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication.
2. G.S. Sudha, "Organizational Behaviour".
3. Robert D.Hisrich, Michael P. Peters, "Entrepreneurship", Tata Me Graw Hill Publishing Company Ltd., 5lh Ed.
4. G.B. Reddy, Intellectual Property Rights and the Law 5th Ed. Gogia Law Agency.